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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KANG-HYUN LEE

Appeal 2008-3836
Application 10/728,706
Technology Center 2800

Decided: September 12, 2008

Before BRADLEY R. GARRIS, ROMULO H. DELMENDO, and
JEFFREY B. ROBERTSON, *Administrative Patent Judges*.

ROBERTSON, *Administrative Patent Judge*.

DECISION ON APPEAL

STATEMENT OF THE CASE

Appellant appeals under 35 U.S.C. § 134(a) (2002) from the
Examiner's rejection of claims 1-18 and 20-22.¹ (Examiner's Answer

¹ Claim 19 has been cancelled. (Appeal Brief filed November 30, 2006, hereinafter "Br.," 36).

entered March 30, 2007, hereinafter “Ans.”). We have jurisdiction pursuant to 35 U.S.C. § 6(b) (2002).

We AFFIRM-IN-PART.

THE INVENTION

Appellant’s claimed invention is directed to a method for fabricating a metal line of a semiconductor device. The method comprises forming an insulation layer on a semiconductor substrate and forming a metal layer on the insulation layer. (Spec. [0019]). The method also comprises forming a photoresist pattern on the metal layer from a photoresist having a thickness of less than 9000 Å, where the pattern has an opening with a width of less than or equal to 0.26 μm, or where a ratio of photoresist thickness to width of the opening is less than about 3.5. (Spec. [0024], [0025]). The method further comprises forming a buffer layer on the photoresist pattern and in the opening, selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines, where the dimension between adjacent metal lines is less than the width of the opening. (Spec. [0027]-[0031]).

Claims 1-4 and 22, reproduced below, are representative of the subject matter on appeal.

1. A method for fabricating a metal line of a semiconductor device, comprising the steps of:
 - a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed;
 - b) forming a metal layer on the insulation layer;
 - c) forming a photoresist pattern having an opening of less than or equal to 0.26 μm width on the metal layer,

wherein said photoresist has a thickness of less than 9000 Å;

- d) forming a buffer layer on the photoresist pattern, including in the opening; and
 - e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than said certain width of said opening.
2. The method of claim 1, further comprising a step of forming an organic anti-reflection coating between the metal layer and the photoresist pattern.
3. The method of claim 2, wherein the buffer layer comprises an oxide film of PE family.
4. The method of claim 3, wherein the buffer layer has a thickness of 180 to 230 Å.
22. A method for fabricating a metal line of a semiconductor device, comprising the steps of:
- a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed;
 - b) forming a metal layer on the insulation layer;
 - c) forming a photoresist pattern having an opening of a certain width on the metal layer, wherein said photoresist has a thickness of less than 9000 Å and a ratio of said photoresist thickness to said certain width of said opening is less than about 3.5;
 - d) forming a buffer layer on the photoresist pattern, including in the opening; and

- e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than said certain width of said opening.

THE REJECTIONS

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Narita	6,383,942	May 7, 2002
Chung	6,750,150	Jun. 15, 2004 (Oct. 18, 2001)

Appellant's admitted prior art in paragraphs [0006]-[0012] of the present Specification.

There are two grounds of rejection before us on appeal: (1) claims 1, 3, 4, 18, and 20-22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background of invention in view of Chung; and (2) claims 2 and 5-17 stand rejected as being unpatentable over Appellant's Background of invention in view of Chung and further in view of Narita.

The Examiner found that Appellant's Background of invention discloses the claimed metal line fabrication method except for forming a buffer layer on the photoresist pattern, where the photoresist has a thickness of less than 9000 Å. (Ans. 3). The Examiner found that Chung teaches a related method for reducing dimensions of a photoresist through application of a buffer layer. (Ans. 4). The Examiner concluded that it would have been obvious to use the buffer layer suggested by Chung on the photoresist pattern in the conventional process disclosed in Appellant's Background of invention in order to increase the precision of patterning and defining of the

photoresist, reduce the dimension of the opening, and lower the photoresist thickness. *Id.*

Regarding claims 2 and 5-17, the Examiner found that Appellant's Background of invention and Chung fail to teach an organic anti-reflection layer (ARC) as well as the lower, intermediate, and upper metal layer structure as claimed. The Examiner found that Narita teaches the claimed organic ARC layer and metal layer structures. The Examiner concluded that it would have been obvious to substitute the aluminum metal layer of Appellant's Background of invention in view of Chung with the metal layer structure of Narita to prevent the metal from being side etched. (Ans. 5).

Appellant contends there is no admission in the Specification that Appellant's Background of invention is prior art. (Br. 16-18). Appellant also argues that the Examiner has failed to explain where the prior art suggests the unexpected improvements of the present invention evidenced by the Declaration of Kang-Hyun Lee, filed on January 12, 2006 (hereinafter "the Lee Declaration"). (Br. 20-23, 26-27). Appellant further argues that claims 3 and 4, which depend directly or indirectly from claim 2, were not properly rejected because the Examiner applied Narita to claim 2, but did not apply Narita to reject claims 3 and 4. (Br. 28 and 29).

ISSUES

Based on Appellant's and the Examiner's contentions, we frame the issues on appeal as follows:

Has Appellant shown that the Examiner erred in relying on Appellant's Specification as admitted prior art?

Has Appellant shown that the Examiner erred in rejecting the appealed claims as being obvious to one of ordinary skill in the art over the cited prior art of record?

If a prima facie case of obviousness exists, has Appellant sufficiently demonstrated unexpected results to overcome the prima facie case?

Has Appellant shown that the Examiner erred in rejecting claims 3 and 4 over Appellant's Background of invention in view of Chung?

We answer the first three questions in the negative and the fourth question in the affirmative.

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence.

1. Appellant's Specification states that a photoresist with a thickness of more than about 9,000 Å is required for metal lines having a critical dimension of less than 0.23 µm. (Spec. [0011]).

2. Appellant's Specification states:

However, a problem arises in that a random metal bridge phenomenon frequently occurs due to decrease of a photo margin as the photoresist pattern becomes thicker, and, to the contrary, when the photoresist pattern becomes thinner to increase the photo margin, a notching phenomenon occurs due to scarcity of the photo margin. (Spec. [0012]).

3. Chung states:

Prior art light sources with lower wavelengths are normally used in a high-resolution photolithographic process. In addition, the depth of focus of a high-resolution photolithographic process is shallower compared to a relative low-resolution photolithographic process. As a result, a

photoresist layer having a lower thickness is required for conventional photolithographic methods. However, a photoresist layer having a lower thickness is susceptible to the subsequent etching steps in a semiconductor manufacturing process. This relative ineffective resistance to etching reduces the precision of patterning and defining of a photoresist. These limitations prevent the dimensions of patterns on a photoresist from being reduced. (Col. 1, ll. 22-34).

4. Chung states:

After the deposition of the second layer 150, the space between the photoresist structures 130 is decreased, for example, from 0.22 microns to 0.02 microns. (Col. 3, ll. 43-45).

5. Chung states:

A first layer 110 is then provided over the wafer substrate 100. In one embodiment, the first layer 110 is a semiconductor material, such as polysilicon. The first layer 110 may also be a dielectric layer or a metal layer. (Col. 2, ll. 64-67).

PRINCIPLES OF LAW

“Section 103 forbids issuance of a patent when ‘the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.’” *KSR Int’l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1734 (2007).

ANALYSIS

Appellant has grouped certain claims subject to the first ground of rejection separately. However, Appellant relies on the same arguments for

some, if not all, the groups. In addition, Appellant relies on many of the same arguments in both the first and second grounds of rejection.

Accordingly, we confine our discussion to appealed claims 1-4, which contain claim limitations representative of the arguments made by Appellant pursuant to 37 C.F.R. § 41.37(c)(1)(vii) (2006).

We are unpersuaded by Appellant's argument that Appellant's Background of invention is not admitted prior art. Appellant argues that "the specification of the present application does not identify any material whatsoever as 'prior art.'" (Br. 18). However, paragraph [0024] of Appellant's Specification states:

Particularly, *in the prior art*, in order to form the metal line 14 having the critical dimension (CD) of less than 0.23 μm , considering the selectivity at the time of dry etching, the opening of the photoresist pattern 18 has to be formed at the same width W as the critical dimension (CD) of the metal line 14 and the photoresist pattern 18 has to be formed at the thickness T of more than 9,000 Å, preferably, 9,500 Å. (Emphasis added).

Thus, Appellant's Specification expressly states that the prior art includes the knowledge that photoresist patterns have to be formed at a thickness of more than 9,000 Å for metal lines having a critical dimension of less than 0.23 μm , as disclosed in Appellant's Background of invention. Therefore, we agree with the Examiner that Appellant's Background of invention in the Specification is admitted prior art.

Appellant additionally argues that the technology discussed in Appellant's Background of invention has not been identified as work of another, and the Examiner has no factual or legal basis for so concluding.

(Br. 18). We are not persuaded. The Examiner's conclusion is completely consistent with the MPEP § 2129 [R-6], which states:

Consequently, the examiner must determine whether the subject matter identified as "prior art" is applicant's own work, or the work of another. *In the absence of another credible explanation, examiners should treat such subject matter as the work of another.* (Emphasis added).

Appellant has not argued that the technology referred to is his own work, but has merely offered "possible" explanations that the technology described in Appellant's Background of invention represent approaches that "could have been" taken by Appellant's coworkers and kept secret before the present invention. (Br. 18). Such unsupported arguments fall far short of a credible explanation sufficient to rebut the Examiner's determination that the technology in Appellant's Background of invention is the work of another.

Appellant's contention that the Examiner should have taken official notice or found a reference disclosing the method described in Appellant's Background of invention is without merit. (Br. 17). The Examiner does not rely on his own personal knowledge or a general well known theory, but the specific conventional process in Appellant's Background of invention admitted as prior art. Relying on admissions as prior art for anticipation and obviousness purposes is proper. *See Riverwood Int'l Corp. v. R.A. Jones & Co.*, 324 F.3d 1346, 1354 (Fed. Cir. 2003). Therefore, we do not find Appellant's arguments persuasive.

Appellant also contends that the Appellant's Background of invention fails to disclose photoresist patterns having a thickness of less than 9,000 Å and that Chung is silent with respect to the thickness of the photoresist

pattern. (Br. 19). Appellant's argument fails to consider what the prior art as a whole conveys to one of ordinary skill in the art. *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971); *In re Simon*, 461 F.2d 1387, 1390 (CCPA 1972). Both Appellant's Background of invention and Chung recognize the problems of the conventional process when the photoresist thickness is greater than 9,000 Å. Appellant's Background of invention discusses the problem of random metal bridges at photoresist thicknesses greater than 9,000 Å, and Chung discusses the need for thinner photoresist thicknesses to meet the required depth of focus of high-resolution photolithographic processes. (FF 1-3). Chung also acknowledges the problems in etching a thinner photoresist in the form of reduced precision of patterning and defining the photoresist. (Ans. 7 and 8; FF 3).

Although Chung does not expressly disclose a photoresist thickness, the admitted prior art in Appellant's Background of invention states that a photoresist with a thickness of more than about 9,000 Å is required for metal lines having a critical dimension of less than 0.23 µm. (FF 1). Since Chung discloses openings having a critical dimension within this range (0.02 µm) (FF 4), the Examiner has provided objective evidence that the lower photoresist thicknesses possible as a result of the buffer layer disclosed in Chung, are thicknesses less than the conventional thickness of about 9,000 Å. (See Ans. 8). The Examiner's conclusion is based on overcoming the deficiencies discussed in the prior art, namely the notching phenomenon disclosed by Appellant's Background of invention and the ineffective resistance to etching disclosed by Chung. (See Ans. 4; FF 2 and 3). In light of the above discussion, we are also unpersuaded by Appellant's arguments that the technology disclosed in Appellant's Background of invention fails to

exist or is not enabled, or that the Examiner's findings regarding the photoresist thickness are inconsistent. (*See* Reply Brief filed May 17, 2007, hereinafter "Rep.," 3, 8).

Appellant additionally argues that the present method provides unexpected results in the form of reduced short circuit-causing defects, specifically "metal stringers," in the gaps between adjacent metal lines. (Br. 20-21). Appellant argues that the Lee Declaration presents evidence of unexpected results, where Appellant's method is said to reduce the "likelihood" of short circuit-causing defects from commercially unacceptably high levels to commercially acceptable levels. (Br. 21-23, Dec. ¶ 14, 15). After careful consideration, we agree with the Examiner that the Lee Declaration is not sufficient to overcome the Examiner's prima facie case of obviousness. (Ans. 11 and 12). It is well settled that mere recognition of latent properties in the prior art does not render nonobvious an otherwise known invention. *In re Baxter Travenol Labs.*, 952 F.2d 388, 392 (Fed. Cir. 1991) (internal citations omitted). Appellant has failed to show that the buffer layer disclosed in Chung would not provide the same likelihood of reduction in short-circuit causing defects as the presently claimed method.

Appellant additionally contends that because Chung discloses other materials for etching besides metal, Chung is not concerned with the problem of "metal stringers." (Rep. 3 and 4). However, Chung clearly discloses metal layers for etching. (FF 5). In addition, the problem with which Appellant is concerned need not be the same problem addressed by the prior art. *See KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. at 1742 (Internal citations omitted). Moreover, Appellant offers no comparative data to

determine the difference between the likelihood of a commercially unacceptable amount of defects and the likelihood of a commercially acceptable amount of defects. *See In re Beattie*, 974 F.2d 1309, 1313 (Fed. Cir. 1992); *In re Grunwell*, 609 F.2d 486, 491 (CCPA 1979). Further, although the Lee Declaration acknowledges that Chung is directed to enhanced etching resistance, the Lee Declaration states that because Chung is silent as to any defect reduction effects, Chung cannot suggest the improvements of the present method. (Dec. ¶ 21). The Lee Declaration states a legal conclusion, without providing any comparative data. As a result, we find that the Lee Declaration does not carry sufficient weight to overcome the Examiner's *prima facie* case. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1372 (Fed. Cir. 2007), *In re Lindell*, 385 F.2d 453 (CCPA 1967).

Regarding claim 2, Appellant additionally argues that Narita's disclosure is consistent with the conventional solutions to the metal stringer problem, i.e., increased thickness of the photoresist, and therefore Narita cannot suggest the improvements in defect reduction provided by the present method. (Br. 32). Again, Appellant's argument fails to consider the rejection as a whole. In responding to a *prima facie* case of obviousness, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. *In re Keller*, 642 F.2d 413, 426 (CCPA 1981); *In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). The Examiner relies on Narita for the stacked metal layer structure and the organic anti-reflection coating, not the teaching of a barrier layer. (Ans. 5 and 11). Thus, Appellant's argument is not persuasive.

Regarding the rejection of claims 3 and 4, we agree with Appellant that the combination of Appellant's Background of invention in view of Chung does not disclose the methods as claimed. (Br. 28). Specifically, the Examiner relies on Narita for the disclosure of an organic anti-reflection coating as claimed in claim 2. (Ans. 5). Claims 3 and 4 both depend from claim 2, thus a rejection of those claims in accordance with the rationale set forth by the Examiner requires a reference to Narita. Because claims 3 and 4 are rejected over Appellant's Background of invention in view of Chung without the inclusion of Narita, the Examiner's decision rejecting claims 3 and 4 is reversed.

CONCLUSION

In light of the above discussion, Appellant has failed to demonstrate that the Examiner erred in rejecting claims 1, 18, and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background of invention in view of Chung; and claims 2 and 5-17 as being unpatentable over Appellant's Background of invention in view of Chung and further in view of Narita. Appellant has demonstrated that the Examiner erred in rejecting claims 3 and 4 under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background of invention in view of Chung.

ORDER

The Examiner's decision rejecting claims 1, 2, 5-18, and 20-22 is affirmed. The Examiner's decision rejecting claims 3 and 4 is reversed.

Appeal 2008-3836
Application 10/728,706

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR §1.136(a)(1)(iv).

AFFIRMED-IN-PART

PL initials:
sld

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